Avalanches of CO2 Frost and the Formation of Recent Martian Gullies

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The observation of small gullies on Mars associated with recent surface runoff might indicate the liquid water stabilization near the surface in recent time despite the cold dry atmosphere. But the models that gullies have been formed by an eruption of trapped fluid in the subsurface, such as groundwater or liquid CO2 cannot explain the observation of gullies originating from isolated peaks and dune crests. In the explanation by melting of near-surface ground ice at high obliquity, a drought of the upper layer caused by the near-surface temperature rise should be considered. Here we show that gullies can be formed by avalanches of CO2 frost which has been condensed on slopes annually. Our calculations of CO2 frost distribution on slopes have good correspondence to latitudes and slope orientations where gullies have been observed. The young undegraded features of gullies can be explained by the surface renewals by CO2 avalanches year after year. No detection of evaporitic deposits indicates that CO2 avalanches are more suitable than flows related to water in which salts can dissolve.